

Awareness and Knowledge of Fire Safety Measures among Medical Students in a Hospital Setting

Gurinder Arora¹, Simran Sharma², Jujhar Singh Rana³, Sukhveer Kaur⁴

^{1,2,4}Assistant Professor, Biomedical & Allied Health Sciences, Baba Farid Group Of Institutions

³Demonstrator, Biomedical & Allied Health Sciences, Baba Farid Group Of Institutions

Abstract

Background - Fires in hospitals are a serious threat, especially in countries like India where safety measures are often lacking. Recent fires in Indian hospitals have caused tragic deaths, exposing gaps in fire safety knowledge. This study aims to assess the awareness and knowledge in medical students about fire safety.

Materials and Methods - The study included 292 (119 males and 173 females) medical students from different fields like physiotherapy, nursing, MBBS, paramedical and dentistry. These students filled an offline questionnaire comprising 2 elements with 12 questions each designed to evaluate various aspects of fire safety.

Results - The findings showed that 50.34% of students had low awareness, while only 17% demonstrated very high awareness. Similarly, 48.6% of the students had poor knowledge, and just 12.7% reached a very high level of knowledge. Overall, the results reflect a general lack of awareness and knowledge among the majority of students.

Conclusion - The study found that over half of medical students lack adequate fire safety awareness (50.34%) and knowledge (48.60%), posing serious risks in emergencies.

Keywords - Fire safety, medical students, hospital safety, hospital fires, emergency training.

Introduction

Heat, light, and flames are released during the beginning of a fire, which is a chemical process marked by rapid oxidation. It is categorized into five varieties according to fuel. Class I, comprises combustible, while Class II, comprises flammable liquids and Class III, encompasses flammable gases Class IV, encompasses combustible metals while Class V, involves cooking oils. A hazard in buildings pertains to the possible threat of unintentional or deliberate fires that present a danger to life, structural soundness and property security. In the context of worldwide progress accelerates, fire risks in structures have changed considerably in terms of both intensity and complexity has emerged as a growing issue in recent years. From 1993 to 2015, there were 86.4 million documented fire events, leading to more than one million deaths (Rather et al., 2024).

The most frequent hazard, which exists in every aspect of life, is fire. In a single minute, a fire may destroy countless of livelihoods and take several hundred lives. (Bashyal et al., 2022). Approximately 25,000 people in India lose their lives to fire and associated incidents each year. India is ranked third in

the world for fire occurrences, primarily in the country's north and west, as reported by India Risk Surveys 2018, which highlights the dangers that fire outbreaks represent to operations and business continuity (Jadhav et al., 2023). As per a home ministry report from the National Crime Records Bureau (NCRB), Maharashtra (3892) had the highest number of fire-related deaths in 2014 (Kulkarni et al., 2016).

Operating room fires are a frequent issue in hospitals, and similar incidents have been noted in clinical offices as well. An estimated 600 surgical fires happen in hospitals each year (Sawhani et al., 2021). Hospitals should be equipped to handle a variety of emergencies, including fire. This is because hospitals have more fires than other locations due to the existence of medicinal gases, combustible materials, and electrical equipment. Hospital fire safety conditions are inadequate in countries with low and medium incomes (Sahebi et al., 2021). A crucial element and prerequisite of constructing infrastructure planning is fire safety. Even in medical settings, it is necessary to have fire safety features such fire hydrant systems, safe gathering places, emergency exits, and several types of fire extinguishers. (Yeturu et al., 2016).

The technological and physical features of hospital infrastructure in India are changing, making healthcare facilities more accessible and affordable to the general public than ever before. The ambiance and facade decorations contribute to the impression that Indian healthcare facilities are "World Class," but the safety and security situation is a worry that requires comparison to the best practices used by institutions in the developed world (Paul et al., 2022). If the construction, contents and occupants of a building have a sufficiently low fire risk, the building may be deemed "very safe" from fire. If residents behave during the evacuation precisely in accordance with the theoretical framework, they can significantly reduce the risk of a fire.

In underdeveloped countries like Russia, India and Iraq, where there is a shortage of firefighting equipment, the bulk of COVID-19-related hospital fires occurred. Fire safety procedures must be understood and followed by frontline healthcare staff in order to prevent fire-related events (Shamaun et al., 2024). By taking a few easy precautions and maintaining fire safety procedures, most fires can be avoided. These safety precautions can be added to buildings during construction or remodelling. Additionally, knowledgeable employees with the right mind-set can be just as vital in preventing and fighting fires. It is crucial for all healthcare professionals, including physicians, medical students and support staff, to understand how to utilise these technologies in various contexts (Sawhani et al., 2021).

There are minimal studies done in India regarding medical students' knowledge of fire safety and preparedness, and each of these investigations revealed that medical students' knowledge of these topics was lacking. Therefore, the purpose of this study is to ascertain the level of fire safety awareness and knowledge among different medical students in an institution. The need for this study is indicated by the high-risk nature of medical environments, regulatory requirements, the benefits of comprehensive education, the enhancement of preparedness and the existing research gap in this area. By addressing the needs, the study contributes to the overall safety and well-being of medical students and broader medical community. By determining the level of awareness among medical students, Critical gaps in knowledge and comprehension of fire and safety procedures can be found through the research. This may result in the creation and application of safer procedures and training initiatives that are more successful. The findings can be used to enhance the curriculum for medical students, ensuring that fire and safety training is an integral part of their education. The aim of the study is to assess the awareness and knowledge regarding fire safety among medical students.

Methods and Materials

A cross-sectional study was conducted at the Hospital utilizing a convenient sampling method. The study population comprises students from associate colleges with the research spanning a duration of four months. Inclusion criteria encompass both male and female students. Exclusion criteria include first-year students and participants unwilling to take part in the study.

Procedure -. A validated questionnaire was formed and reviewed by 8 experts and changes were made accordingly for the face validity of questionnaire. The pilot study was done prior to final study. 292 subjects were taken according to the selection criteria. The study commenced only after obtaining informed consent from the participants. The questionnaire was distributed to participants via offline paper mode. After the completion of the study, data was analysed.

Tools used - Fire and Safety questionnaire (FSQ) is a 24 question self-reported questionnaire developed to check fire safety awareness and knowledge among medical students. It has two elements with 12 questions each for assessing awareness and knowledge.

Data analysis - An overall and gender wise awareness and knowledge were calculated by percentage; the data was also distributed according to colleges and college wise result was also calculated by percentage. Kruskal-Wallis's test was first applied due to non-normality of data, which revealed significant differences ($p=0.000$). Then Mann-Whitney U tests were applied for pairwise comparisons to identify specific differences among colleges and gender.

Result

This study aimed to assess awareness and knowledge regarding fire safety among medical students in a hospital setting. A total of 292 participants out of which 119 were males and 173 were females completed an offline questionnaire comprising 2 elements with 12 questions each designed to evaluate various aspects of fire safety.

Figure 1.1. Distribution of students gender wise.

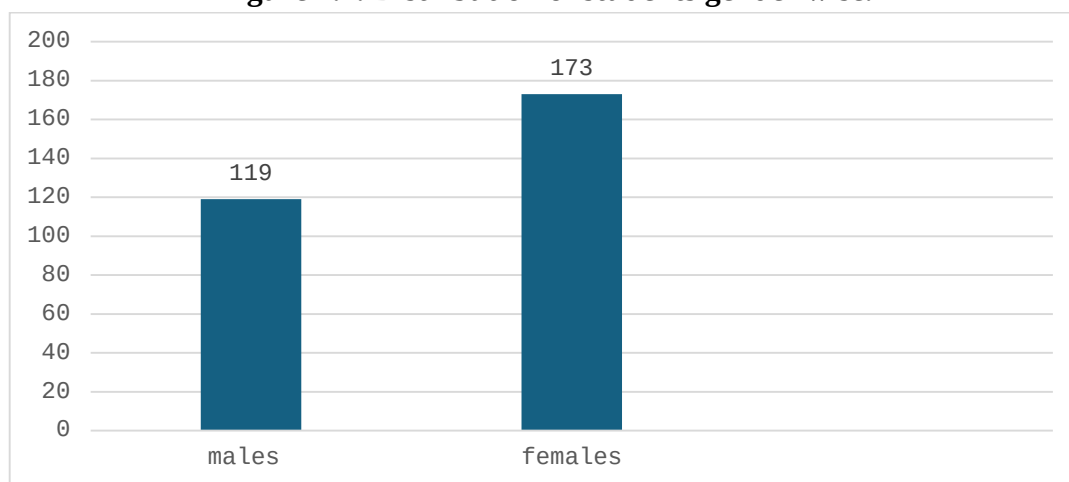


Figure 1.1. describes distribution of subjects on the basis of gender. After the selection of subjects according to inclusion and exclusion criteria, total number of subjects were 292 out of which 119 were male and 173 were female.

Figure 1.2. Distribution of students college wise.

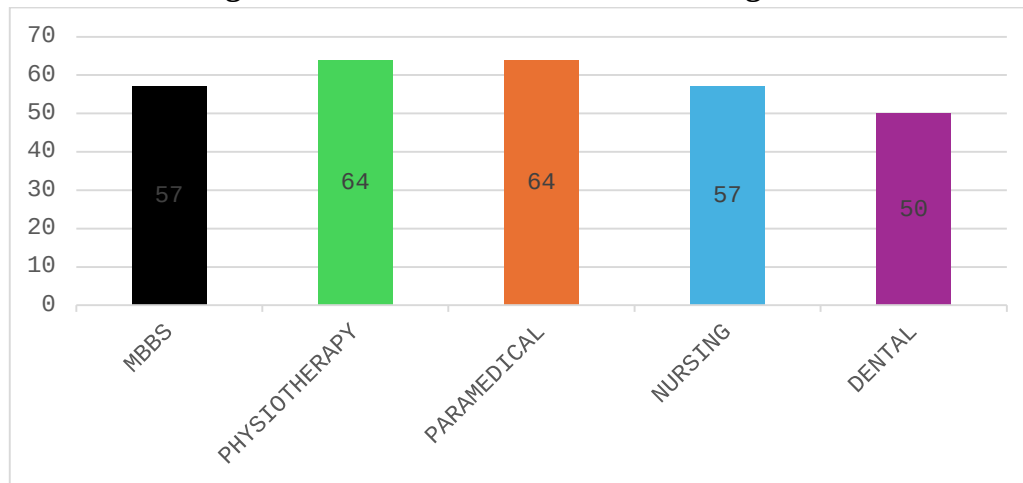


Figure 1.2. describes the total number of participants distributed according to the colleges. After the selection of subjects according to inclusion and exclusion criteria total number of subjects were 292 of which 64 subjects were from physiotherapy students and paramedical students each and 57 subjects were nursing students and mbbs students each and 50 subjects were dental students.

Figure 1.3. Total awareness among students.

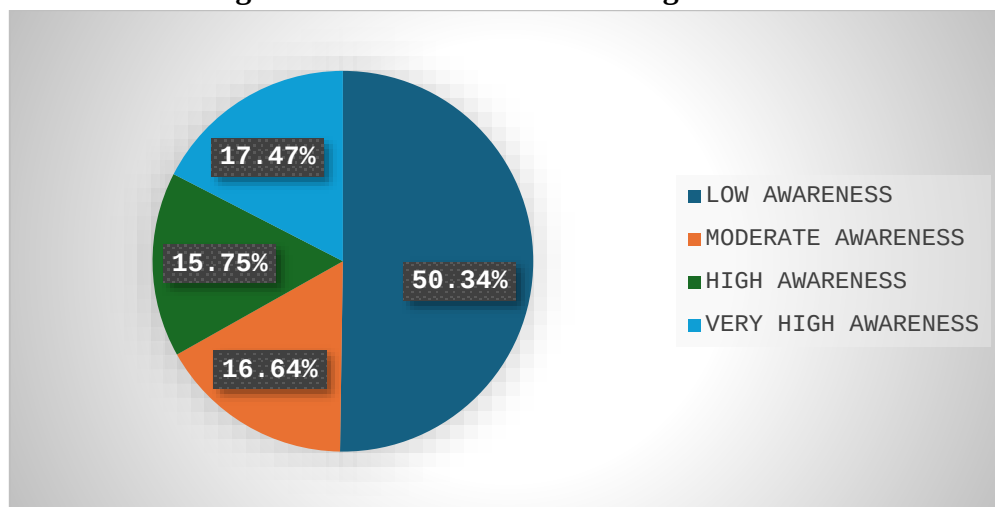


Figure 1.3. describes 50.34% of medical students fall under the category of low awareness regarding fire safety. 16.64% of students are classified as having moderate awareness, while 15.75% fall under the high awareness category. The remaining 17.47% of students are categorized as having very high awareness of fire safety.

Figure 1.4. Total knowledge among students.

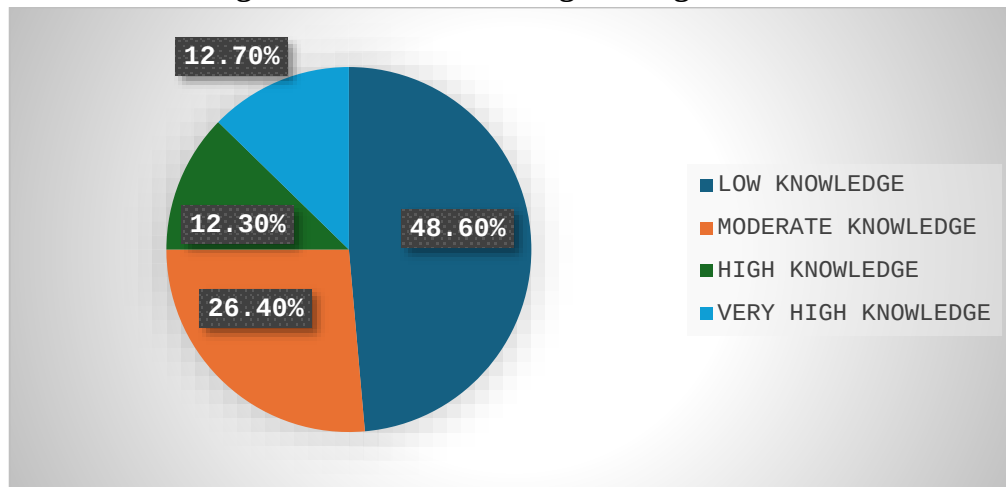


Figure 1.4. describes 48.60% of medical students fall under the category of low knowledge regarding fire safety, 26.40% of students are categorized as having moderate knowledge, while 12.30% have high knowledge. The remaining 12.70% of students are classified as having very high knowledge of fire safety.

Figure 1.5. Total awareness among male students.

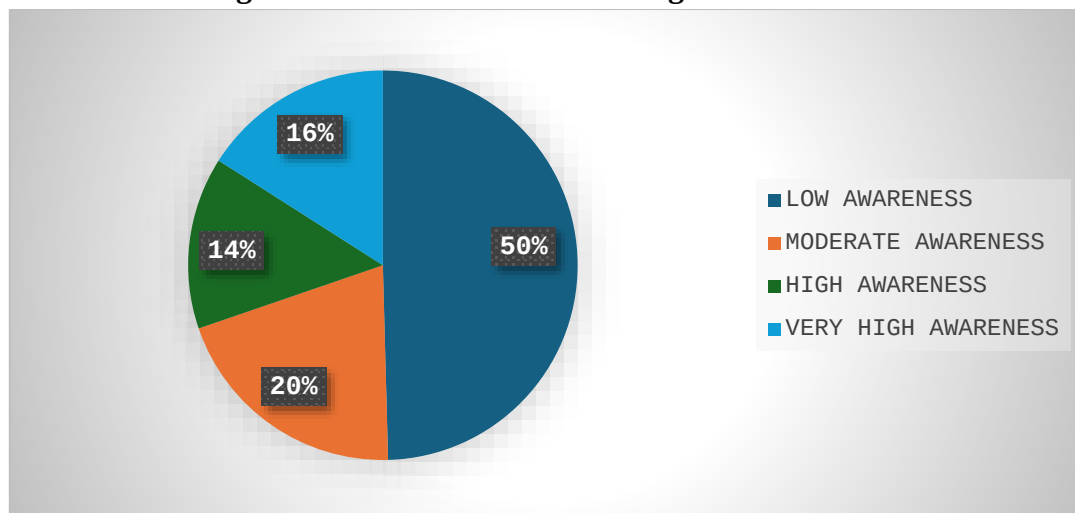


Figure 1.5. describes 50% of males fall under the category of low awareness, 20% are classified as having moderate awareness, while 14% fall under the high awareness category. The remaining 16% are categorized as having very high awareness.

Figure 1.6. Total awareness among female students.

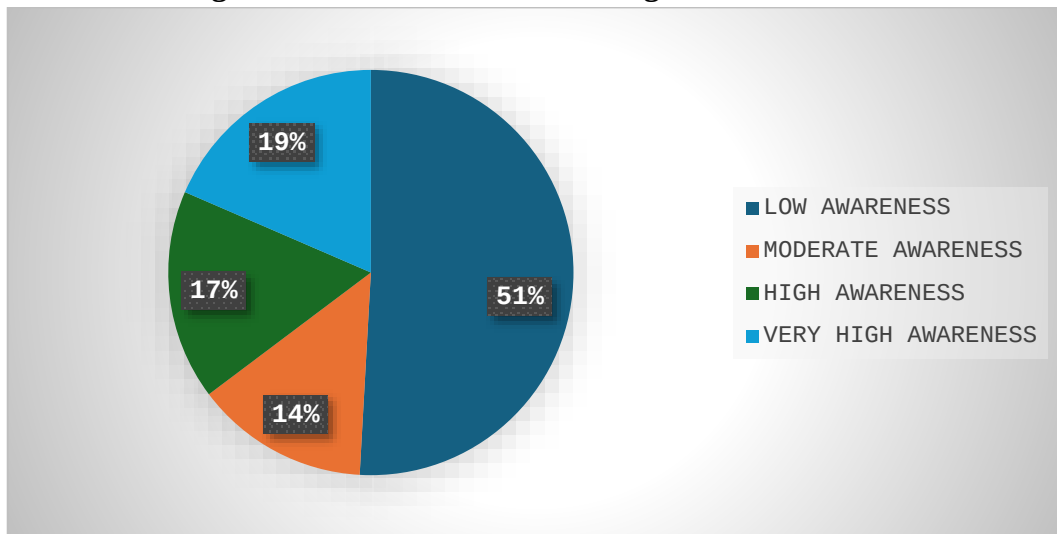


Figure 1.6. describes 51% of females fall under the category of low awareness, 14% are classified as having moderate awareness, while 17% fall under the high awareness category. The remaining 19% are categorized as having very high awareness.

Figure 1.7. Total knowledge among male students.

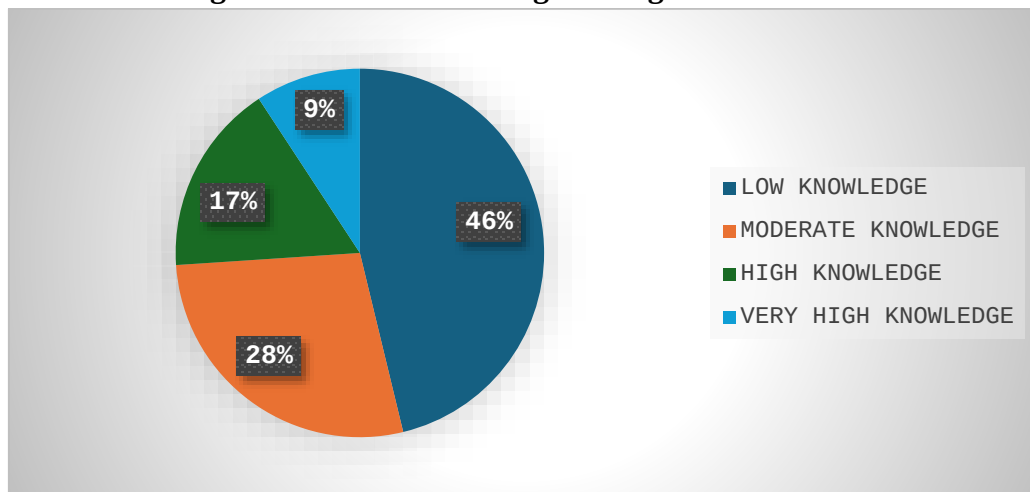


Figure 1.7. describes 46% of males fall under the category of low knowledge, 28% are classified as having moderate knowledge, while 17% fall under the high knowledge category. The remaining 9% are categorized as having very high knowledge.

Figure 1.8. Total knowledge among female students.

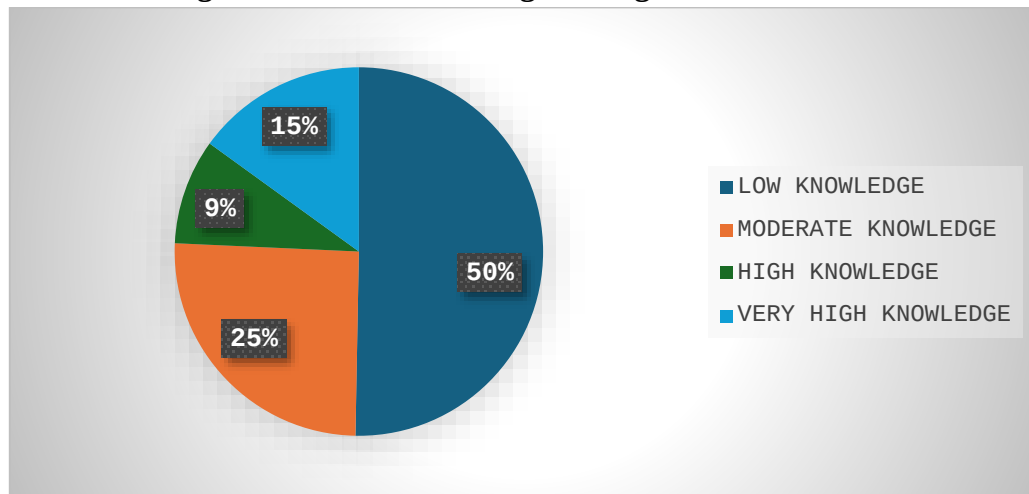


Figure 1.8. describes 50% of females fall under the category of low knowledge, 25% are classified as having moderate knowledge, while 9% fall under the high knowledge category. The remaining 15% are categorized as having very high knowledge.

Figure 1.9. Awareness among mbbs students.

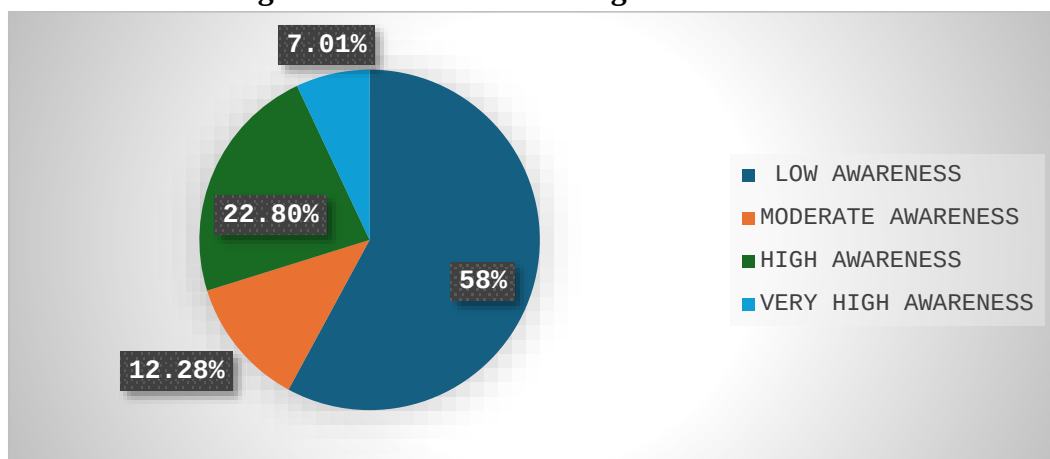


Figure 1.9. describes 58% of students had low awareness, 12.28% have moderate awareness and 22.80% and 7.01% have high and very high awareness respectively.

Figure 4.10. Awareness among physiotherapy students.

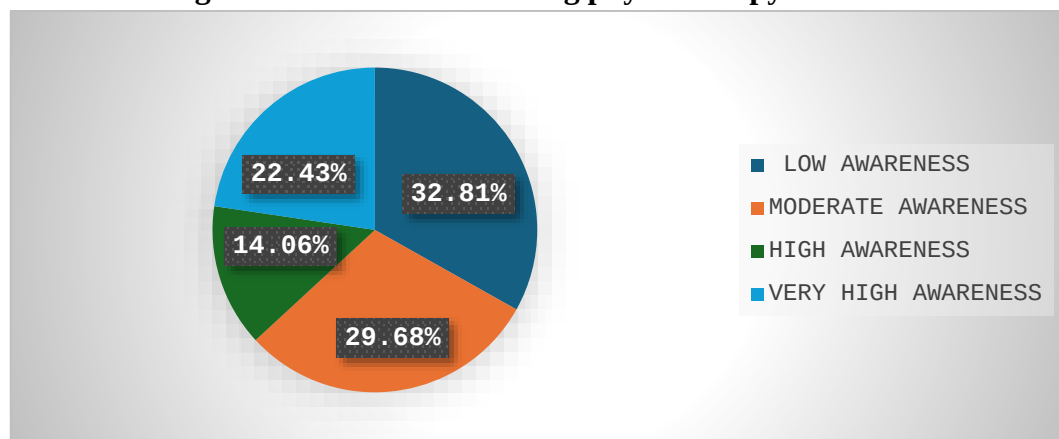


Figure 1.10. describes 32.81% of students had low awareness, 29.68% have moderate awareness and 14.06% and 22.43% have high and very high awareness respectively.

Figure 1.11. Awareness among paramedical students.

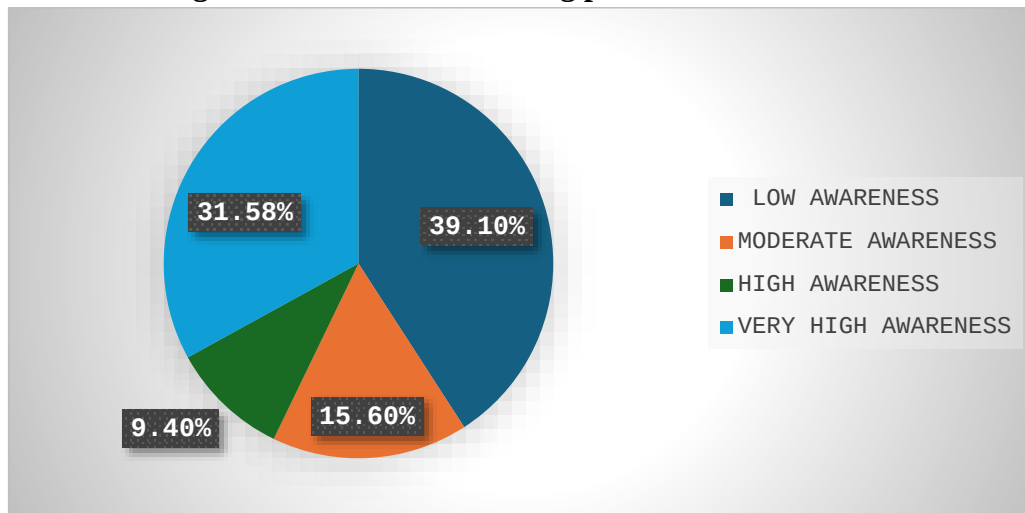


Figure 1.11. describes 39.10% of students had low awareness, 15.60% have moderate awareness and 9.40% and 31.58% have high and very high awareness respectively.

Figure 1.12. Awareness among nursing students.

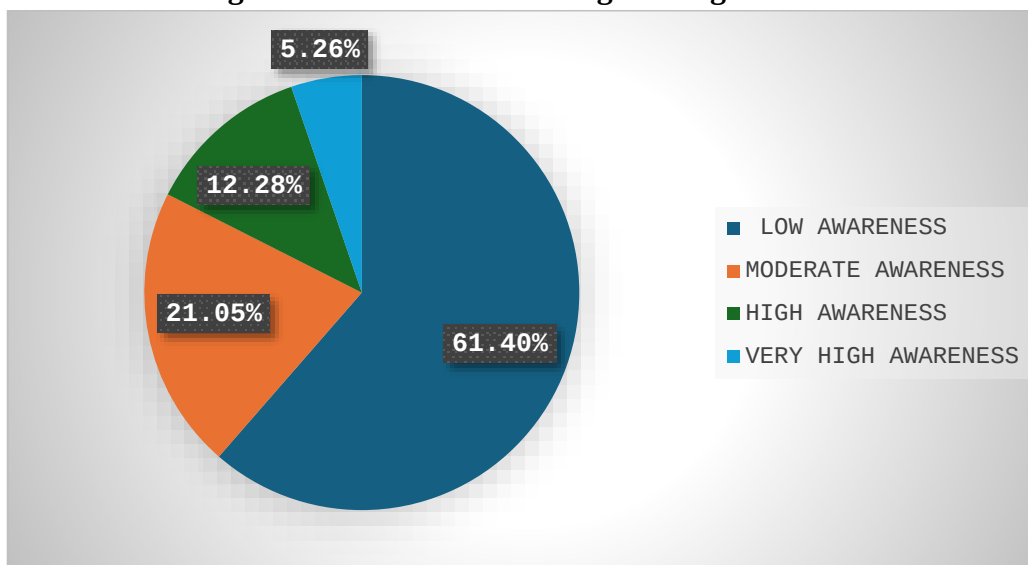


Figure 1.12. describes 61.40% of students had low awareness, 21.05% have moderate awareness and 12.28% and 5.26% have high and very high awareness respectively.

Figure 1.13. Awareness among dental students.

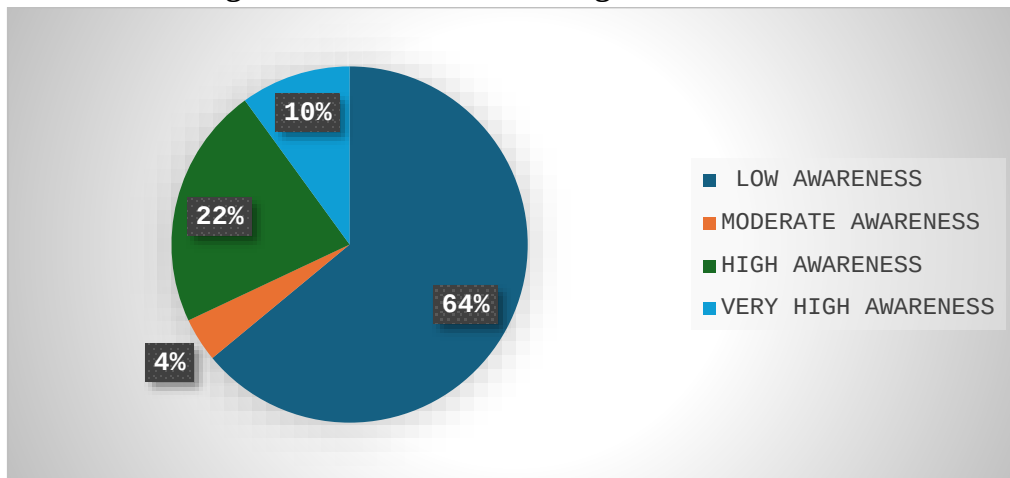


Figure 1.13. describes 64% of students had low awareness, 4% have moderate awareness and 22% and 10% have high and very high awareness respectively.

According to the above presented distribution of fire safety awareness across different colleges, dental students and nursing students show the highest percentage of low awareness at 64% and 61.4% respectively. Paramedical students have the highest percentage of very high awareness (31.58%), indicating effective fire safety education or initiatives. Physiotherapy students show a balanced distribution, with relatively lower low awareness and higher moderate to very high awareness scores. MBBS students and dental students reflect major areas for intervention due to over 55% of students in the low awareness category.

Figure 1.14. Knowledge among mbbs students.

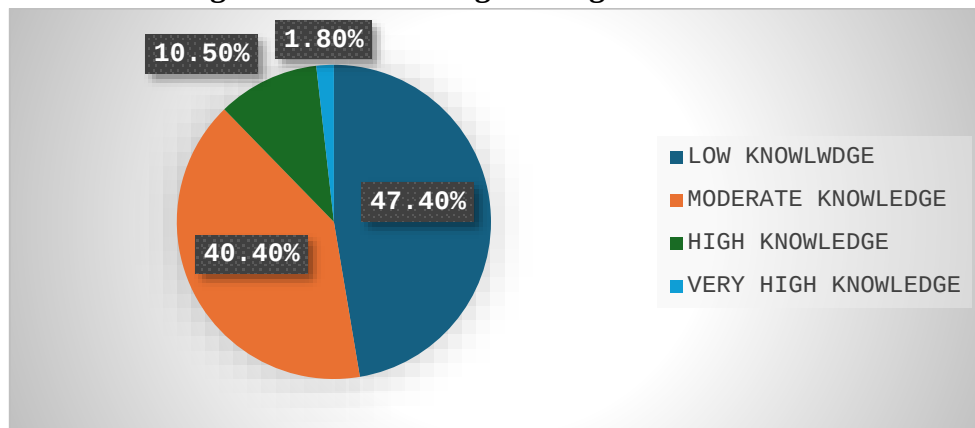


Figure 1.14. describes 47.40% of students had low knowledge, 40.40% have moderate knowledge and 10.50% and 1.80% have high and very high knowledge respectively.

Figure 1.15. Knowledge among physiotherapy students.

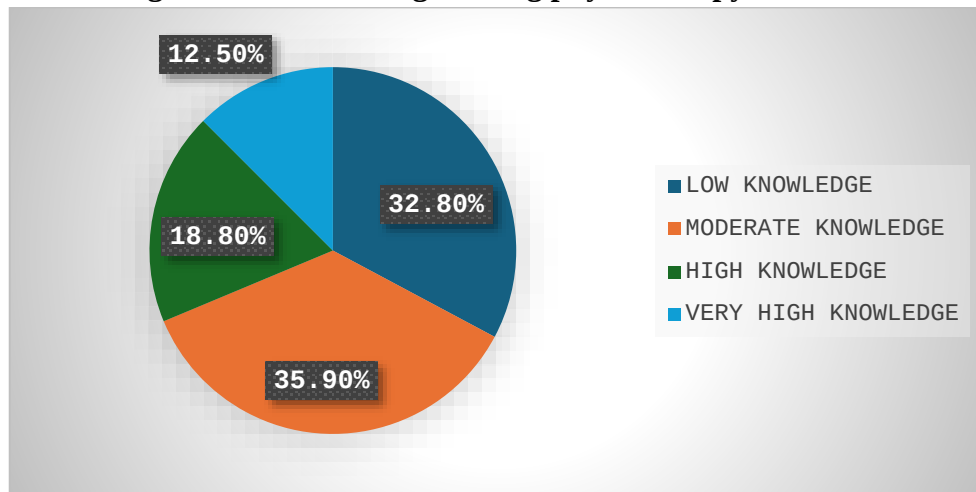


Figure 1.15. describes 32.80% of students had low knowledge, 35.90% have moderate knowledge and 18.80% and 12.50% have high and very high knowledge respectively.

Figure 1.16. Knowledge among paramedical students.

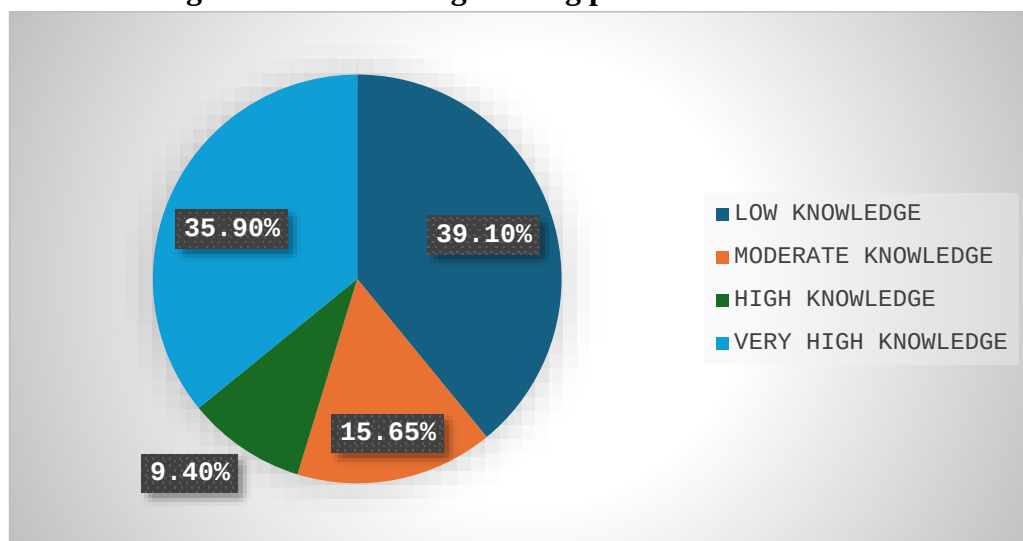


Figure 1.16. describes 39.10% of students had low knowledge, 15.65% have moderate knowledge and 9.40% and 35.90% have high and very high knowledge respectively.

Figure 1.17. Knowledge among nursing students.

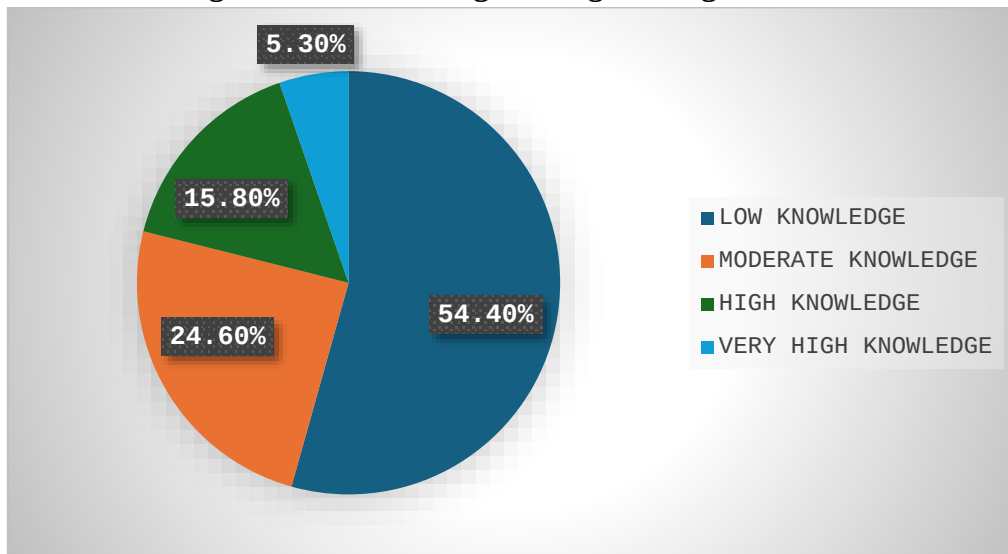


Figure 1.17. describes 54.40% of students had low knowledge, 24.60% have moderate knowledge and 15.80% and 5.30% have high and very high knowledge respectively.

Figure 1.18. Knowledge among dental students.

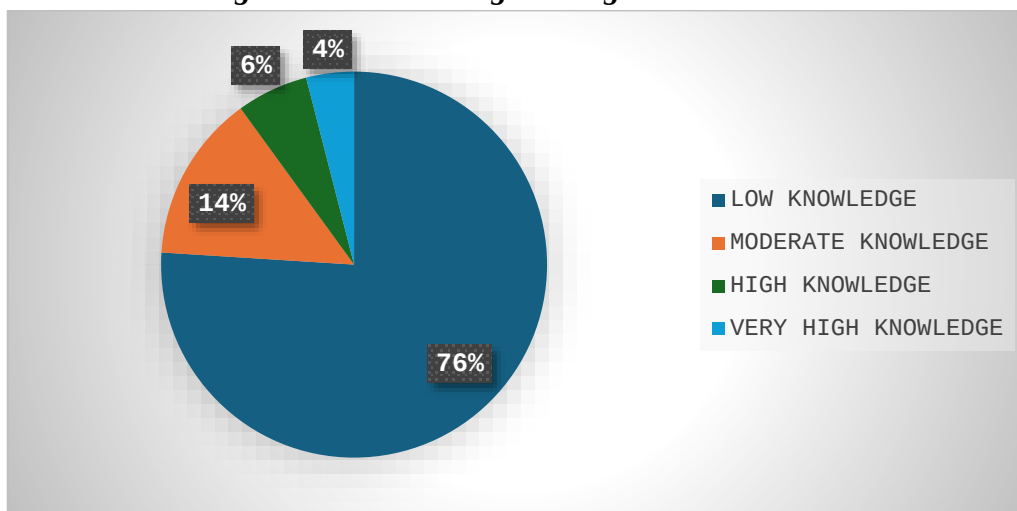


Figure 1.18. describes 76% of students had low knowledge, 14% have moderate knowledge and 6% and 4% have high and very high knowledge respectively.

According to the above presented distribution of fire safety knowledge across different colleges, paramedical students stand out with 35.9% of in the very high knowledge category, the highest among all colleges. Physiotherapy students had 31.3% (high (18.80%) + very high (12.50%)) knowledge levels. 76% of dental students has low knowledge only 10% combined in high/very high knowledge. Nursing students is also concerning, with 54.4% low knowledge. Physiotherapy students have the most even distribution, with relatively lower low-knowledge levels and reasonable proportions in all other categories. MBBS students has a high percentage in the moderate category (40.4%), indicating potential for improvement with minimal effort. Dental students and nursing students need urgent educational outreach, with more than half of their students scoring in the low knowledge category.

Table 1.1. Mann-whitney U test results for awareness levels by gender.

Comparison	N (female)	N (male)	Mann-Whitney U	Z-score	Asymptotic Sig. (2-tailed)	Effect Size (r)
Female vs Male	173	119	9969.500	-0.458	0.647	-0.0268

Table 1.1. describes the Mann-Whitney U test comparing awareness levels between female (N = 173) and male (N = 119) students showed no significant difference (U = 9969.500, Z = -0.458, p = 0.647, r = -0.0268). The negligible effect size indicates minimal difference in awareness, suggesting similar awareness levels between genders.

Table 1.2. Mann-whitney U test results for knowledge levels by gender.

Comparison	N (female)	N (male)	Mann-Whitney U	Z-score	Asymptotic Sig. (2-tailed)	Effect Size (r)
Female vs Male	173	119	10117.000	-0.250	0.803	-0.0146

Table 1.2. describes the Mann-Whitney U test comparing knowledge levels between female (N = 173) and male (N = 119) students showed no significant difference (U = 10117.000, Z = -0.250, p = 0.803, r = -0.0146). The negligible effect size indicates minimal difference in knowledge, suggesting similar knowledge levels between genders.

Table 1.3. Mann-whitney U test results for awareness levels across colleges.

College Pair	N (College 1)	N (College 2)	Mann-Whitney U	Z-Score	Asymptotic Sig. (2-tailed)	Effect size(r)
MBBS vs. Physiotherapy	57	64	1369.500	-2.370	0.018	0.215
MBBS vs. Paramedical	57	64	1161.500	-3.454	0.001	0.314
MBBS vs. Nursing	57	57	1498.500	-0.717	0.473	0.067
MBBS vs. Dental	57	50	1231.000	-1.217	0.224	0.118
Physiotherapy vs. Paramedical	64	64	1705.000	-1.639	0.101	0.145

Physiotherapy vs. Nursing	64	57	1378.000	-2.321	0.020	0.211
Physiotherapy vs. Dental	64	50	1297.000	-1.735	0.083	0.162
Paramedical vs. Nursing	64	57	1302.000	-2.722	0.006	0.247
Paramedical vs. Dental	64	50	1139.000	-2.645	0.008	0.248
Nursing vs. Dental	57	50	1416.000	-0.056	0.955	0.005

Table 1.3. describes the Mann-Whitney U tests conducted to compare awareness levels across various college pairs revealed several significant differences. MBBS differed significantly from Physiotherapy ($U = 1369.500$, $Z = -2.370$, $p = 0.018$, $r = 0.215$) and Paramedical ($U = 1161.500$, $Z = -3.454$, $p = 0.001$, $r = 0.314$), with small to medium effect sizes, indicating moderate practical significance in awareness differences. However, MBBS showed no significant difference in awareness from Nursing ($U = 1498.500$, $Z = -0.717$, $p = 0.473$, $r = 0.067$), with a small effect size, and no significant difference from Dental ($U = 1231.000$, $Z = -1.217$, $p = 0.224$, $r = 0.118$). Physiotherapy and Paramedical were not significantly different in awareness ($U = 1705.000$, $Z = -1.639$, $p = 0.101$, $r = 0.145$), with a small effect size, but Physiotherapy differed significantly from Nursing ($U = 1378.000$, $Z = -2.321$, $p = 0.020$, $r = 0.211$) and showed a marginally non-significant difference from Dental ($U = 1297.000$, $Z = -1.735$, $p = 0.083$, $r = 0.162$). Paramedical differed significantly in awareness from Nursing ($U = 1302.000$, $Z = -2.722$, $p = 0.006$, $r = 0.247$) and Dental ($U = 1139.000$, $Z = -2.645$, $p = 0.008$, $r = 0.248$), both with small to medium effect sizes. Nursing and Dental showed no significant difference in awareness ($U = 1416.000$, $Z = -0.056$, $p = 0.955$, $r = 0.005$), with a negligible effect size. Overall, comparisons involving Paramedical, particularly with MBBS and Nursing, showed larger effect sizes, suggesting more substantial awareness differences, while Nursing and Dental were most similar in awareness levels. These findings highlight varying degrees of awareness differences across college programs, with Paramedical standing out as distinct in several comparisons.

Table 1.4. Mann-whitney U test results for knowledge levels across colleges.

College Pair	N (College 1)	N (College 2)	Mann-Whitney U	Z-Score	Asymptotic Sig. (2-tailed)	Effect size (r)
MBBS vs Physiotherapy	57	64	1315.000	-2.650	0.008	0.241
MBBS vs Paramedical	57	64	1284.500	-2.812	0.005	0.255
MBBS vs Nursing	57	57	1618.000	-0.037	0.970	0.003
MBBS vs Dental	57	50	1118.000	-1.927	0.054	0.186

Physiotherapy vs Paramedical	64	64	1852.000	-0.937	0.349	0.083
Physiotherapy vs Nursing	64	57	1314.000	-2.653	0.008	0.241
Physiotherapy vs Dental	64	50	857.500	-4.251	0.000	0.398
Paramedical vs Nursing	64	57	1265.500	-2.912	0.004	0.265
Paramedical vs Dental	64	50	878.500	-4.143	0.000	0.388
Nursing vs Dental	57	50	1136.500	-1.812	0.070	0.175

Table 1.4. describes the Mann-Whitney U tests conducted to compare knowledge levels across various college pairs revealed several significant differences. MBBS differed significantly from Physiotherapy ($U = 1315.000$, $Z = -2.650$, $p = 0.008$, $r = 0.241$) and Paramedical ($U = 1284.500$, $Z = -2.812$, $p = 0.005$, $r = 0.255$), both with small to medium effect sizes, indicating moderate practical significance in knowledge differences. However, MBBS showed no significant difference in knowledge from Nursing ($U = 1618.000$, $Z = -0.037$, $p = 0.970$, $r = 0.003$), with a negligible effect size, and only a marginally non-significant difference from Dental ($U = 1118.000$, $Z = -1.927$, $p = 0.054$, $r = 0.186$). Physiotherapy and Paramedical were not significantly different in knowledge ($U = 1852.000$, $Z = -0.937$, $p = 0.349$, $r = 0.083$), with a very small effect size, but Physiotherapy differed significantly from Nursing ($U = 1314.000$, $Z = -2.653$, $p = 0.008$, $r = 0.241$) and Dental ($U = 857.500$, $Z = -4.251$, $p < 0.001$, $r = 0.398$), the latter showing a medium to large effect size in knowledge. Paramedical also differed significantly in knowledge from Nursing ($U = 1265.500$, $Z = -2.912$, $p = 0.004$, $r = 0.265$) and Dental ($U = 878.500$, $Z = -4.143$, $p < 0.001$, $r = 0.388$), with the latter comparison also indicating a medium to large effect size. Nursing and Dental showed a marginally non-significant difference in knowledge ($U = 1136.500$, $Z = -1.812$, $p = 0.070$, $r = 0.175$). Overall, comparisons involving Dental consistently showed larger effect sizes, suggesting more substantial knowledge differences, while MBBS and Nursing were most similar in knowledge levels. These findings highlight varying degrees of knowledge differences across college programs, with Dental standing out as distinct in several comparisons.

Discussion

The purpose of this study was to assess medical students' awareness and knowledge in a hospital setting. A total of 292 subjects, out of which 119 were males and 173 were females, filled the questionnaire by offline method. It was found that 50.34% of medical students fall under the category of low awareness regarding fire safety, 16.64% are classified as having moderate awareness, 15.75% fall under the high awareness category, and 17.47% are categorized as having very high awareness. For knowledge, 48.60% of medical students fall under low knowledge, 26.40% have moderate knowledge, 12.30% have high knowledge, and 12.70% have very high knowledge. Gender comparisons show no significant differences in awareness ($U=9969.500$, $p=0.647$) or knowledge ($U=10117.000$, $p=0.803$). College pair analyses

indicate significant awareness differences in MBBS vs. Paramedical ($p=0.001$), Physiotherapy vs. Nursing ($p=0.020$), and Paramedical vs. Dental ($p=0.008$), and significant knowledge differences in Physiotherapy vs. Dental ($p<0.001$) and Paramedical vs. Dental ($p<0.001$). Awareness levels are similar among males and females, with 50% and 51% respectively falling under low awareness, while females show slightly higher very high awareness (19%) compared to males (16%). In terms of knowledge, 46% of males and 50% of females have low knowledge, but more males (28%) fall under moderate knowledge compared to females (25%), while females show a higher percentage in the very high knowledge category (15% vs. 9%). According to these findings, a significant percentage of students exhibit a worrisome lack of awareness and understanding, underscoring the necessity of better fire safety instruction and training in the medical curriculum to guarantee emergency readiness.

Sholanke et al. (2024) carried out a study in a Nigerian college, supports the findings of current research by highlighting a lack of knowledge among students regarding basic fire prevention and safety measures. Using a structured questionnaire and quantitative analysis, it revealed that most students were unaware of fire and emergency safety protocols, including the locations of fire and emergency exits and safety signs. The study emphasizes the importance of regular fire drills and training in academic environments to improve preparedness and align with safety best practice reinforcing the need for improved fire safety education found in current study.

Yeturu et al. (2016) carried out a study at the Amrita School of Dentistry assessed the dental students and staff's knowledge and attitude toward fire safety, revealing that while many participants had a positive attitude, only a few knew how to effectively use fire control measures during emergencies. It highlighted a concerning gap between perceived awareness and actual practical knowledge, with participants lacking confidence in handling real-life fire situations. Similarly, current study found that a significant portion of medical students fell into the low awareness and low knowledge categories regarding fire safety. Thus, the findings of this study align with current study, supporting the conclusion that a widespread necessity of enhanced fire safety education in healthcare educational environments is needed.

Rather et al. (2024) conducted a study in Srinagar, Jammu & Kashmir, and found notable gaps in healthcare personnel's understanding and readiness for fire safety, despite a positive attitude toward its importance. Participants lacked awareness of fire prevention strategies and emergency protocols, similar to findings in current study where many medical students had low fire safety awareness and knowledge.

Soman et al. (2024) conducted research in a tertiary care hospital, results revealed only 1% of healthcare professionals had excellent fire safety knowledge, 82% had average to good knowledge and 17% had poor to below-average knowledge. This is similar to current study findings, indicating that overall awareness needs improvement. These results highlight the urgent necessity for regular fire safety education and mock training drills in healthcare settings.

The study has several limitations, including a limited sample size drawn from a single setting, which may restrict the findings' generalisability. Furthermore, using self-reported data raises the possibility of bias because responses might not be an accurate representation of participants' actual behaviours or knowledge. The study also focuses solely on general awareness and knowledge, without assessing practical skills, which can offer a more thorough comprehension of the topic. Despite these limitations, the study offers significant future scope. It provides valuable data and insights that can support academic research and enhance learning outcomes. The results can guide the creation and assessment of efficient fire safety regulations and protocols, ensuring they are evidence-based and aligned with safety standards.

Furthermore, the research emphasises the potential for integrating structured fire safety training into the medical curriculum to better prepare students for real-world scenarios.

Conclusion

The findings of this study reveal a serious deficiency in both knowledge and awareness of fire safety in medical students, with more than half exhibiting low levels in these critical areas. Specifically, 50.34% demonstrated low awareness and 48.60% showed low knowledge regarding fire safety procedures. Awareness levels are similar among males and females, with 50% and 51% respectively falling under low awareness, while females show slightly higher very high awareness (19%) compared to males (16%). In terms of knowledge, 46% of males and 50% of females have low knowledge, but more males (28%) fall under moderate knowledge compared to females (25%), while females show a higher percentage in the very high knowledge category (15% vs. 9%). These gaps pose potential risks in emergency situations, particularly in healthcare environments where quick and informed responses are vital. Therefore, there is an urgent need to integrate comprehensive fire safety instruction and practical training into the medical curriculum. Doing so will enhance preparedness, ensure student safety and contribute to a more resilient healthcare workforce.

References

1. Almatared, M., Liu, H., Abudayyeh, O., Hakim, O., & Sulaiman, M. (2023). Digital-twin-based fire safety management framework for smart buildings. *Buildings*, 14(1), 4. <https://doi.org/10.3390/buildings14010004>
2. Babatunde, S.A., Oche, A.G., & Paul, O. (2020). Fire emergency safety preparedness in the college of leadership development studies building in covenant university, Ota, Nigeria. *Architecture*, 8(6), 1463–1480. <https://doi.org/10.13189/cea.2020.080628>
3. Babalola, A., Manu, P., Cheung, C., Yunusa-Kaltungo, A., & Bartolo, P. (2023). Applications of immersive technologies for occupational safety and health training and education: A systematic review. *Safety Science*, 166, 106214. <https://doi.org/10.1016/j.ssci.2023.106214>
4. Bansal, S., & Gupta, A. (2024). *Text book on hospital hazards & disaster management*. Academic Guru Publishing House.
5. Bashyal, C., Mishra, A. K., & Aithal, P. S. (2022). Fire safety compliance among hospital buildings: A case study from Nepal-Asia. *International Journal of Research -GRANTHAALAYAH*, 10(10), 33–57. doi:10.29121/granthaalayah.v10.i10.2022.4827
6. Bose, M., Latha, & Arumugam, D. I. (2019). A study to assess the knowledge regarding fire accidents among nurses working at Narayana Medical College Hospital, Nellore Andhra Pradesh. *International Journal of Advance Research in Community Health Nursing*, 1(1), 11–13. doi:10.33545/26641658.2019.v1.i1a.5
7. Cameron, S. (2024). *Understanding factors associated with dangerous fires and repeat arson* [Master's thesis, Te Herenga Waka – Victoria University of Wellington].
8. Che Huei, L., Ya-Wen, L., Chiu Ming, Y., Li Chen, H., Jong Yi, W., & Ming Hung, L. (2020). Occupational health and safety hazards faced by healthcare professionals in Taiwan: A systematic review of risk factors and control strategies. *SAGE Open Medicine*, 8, 2050312120918999. <https://doi.org/10.1177/2050312120918999>

9. Fernández-Vigil, M., Gil Rodríguez, B., & Echeverría Trueba, J. (2020). Fire safety strategies to reduce mortality in dwellings occupied by elderly people: The Spanish case. *Fire Technology*, 56(5), 2257–2281. <https://doi.org/10.1007/s10694-020-00989-5>
10. Jaafar, M., Salim, N. A. A., Salleh, N. M., Sulieman, M. Z., Ulang, N. M., & Ebekozién, A. (2023). Developing a framework for fire safety management plan: The case of Malaysia's public hospital buildings. *International Journal of Building Pathology and Adaptation*, 41(4), 713–733. <https://doi.org/10.1108/IJBPA-07-2022-0105>
11. Jadhav, P., Tanvi, Snehal, Shubham, Abhijit, & Baliram. (2023). A Study to Assess Knowledge and Practices regarding Fire Safety among Health care workers in selected Hospitals of Pune City. *International Journal of Nursing Education and Research*, 189–192. doi:10.52711/2454-2660.2023.00043
12. Juyal, S., Tabassum-Abbasi, Abbasi, T., & Abbasi, S. A. (2023). An analysis of failures leading to fire accidents in hospitals; with specific reference to India. *Journal of Failure Analysis and Prevention*, 1–12. doi:10.1007/s11668-023-01668-x
13. Khan, H. S., & Hanif, R. (n.d.). *Exploration of workplace hazards faced by healthcare workers in Pakistan*.
14. Kihila, J. M. (2017). Fire disaster preparedness and situational analysis in higher learning institutions of Tanzania. *Jamba (Potchefstroom, South Africa)*, 9(1), 311. doi:10.4102/jamba.v9i1.311
15. Kim, J. (2022). *A multimodal approach to improve fire safety on construction sites* [Master's thesis, Oklahoma State University].
16. Kulkarni, R., Giri, P., & Gangwal, P. (2016). Knowledge and practices regarding fire safety amongst health care workers in tertiary care teaching hospital in Marathwada region of Maharashtra, India. *International Journal of Community Medicine and Public Health*, 1900–1904. doi:10.18203/2394-6040.ijcmph20162062
17. Kumar, K., & Paul, V. K. (2022). A critical review of risk factors and reliability assessment issues of fire and life safety in buildings. *International Journal of Research Publication and Reviews*, Vol 4, no 10, pp 197-200. <https://www.ijrpr.com>
18. Li, W.-C., Tseng, J.-M., & Huang, H.-S. (2022). Effectiveness of advanced fire prevention and emergency response training at nursing homes. *International Journal of Environmental Research and Public Health*, 19(20), 13185. doi:10.3390/ijerph192013185
19. Mani, Z. A., Khorram-Manesh, A., Alotaibi, H., & Goniewicz, K. (2024). Global catastrophe of hospital disasters: A retrospective analysis (1976–2023). *Signa Vitae*, 1, 12. <https://doi.org/10.22514/sv.2023.094>
20. Meechang, K., Leelawat, N., Tang, J., Kodaka, A., & Chintanapakdee, C. (2020). The acceptance of using information technology for disaster risk management: A systematic review. *Engineering Journal*, 24(4), 111–132. <https://doi.org/10.4186/ej.2020.24.4.111>
21. Moradi, S. M., Nekoei Moghadam, M., Abbasnejad, A., & Hasheminejad, N. (2021). Risk analysis and safety assessment of hospitals against disasters: A systematic review. *Journal of Education and Health Promotion*, 11(10), 1–16. https://doi.org/10.4103/jehp.jehp_860_20
22. Muhamad Salleh, N., Agus Salim, N. A., Jaafar, M., Sulieman, M. Z., & Ebekozién, A. (2020). Fire safety management of public buildings: A systematic review of hospital buildings in Asia. *Property Management*, 38(4), 497–511. <https://doi.org/10.1108/PM-09-2019-0053>

23. Okolieuwa, C. C., Christopher, I. I., & Ikwunne, T. (2023). Impact and significance of occupational health and safety policies on workers' performance in workplace: A case study of NNPC, Enugu Depot. *American Journal of Applied Sciences and Engineering*, 4(1), 24–37. <https://doi.org/10.47672/ajaseng.1311>
24. Patel, K. (2024). Development and implementation of an emergency preparedness policy and procedure, educational intervention and in-situ simulation in a paediatric primary care office: A quality improvement project. https://scholarworks.umb.edu/nursing_dnp_capstone/39
25. Patharla, S. S. R., Pyreddy, S. R., & Panthagani, S. N. (2020). A study on reported fire incidents in major hospitals of India. *International Journal of Community Medicine and Public Health*, 7(10), 3896. doi:10.18203/2394-6040.ijcmph20204351
26. Paul, V. K., Basu, C., Rastogi, A., & Kumar, K. (2022). Status of fire safety in healthcare facilities in India. *International Journal of Architecture and Infrastructure Planning*, 8(1), 1–11. <https://doi.org/10.37628/jaip.v8i1.87>
27. Rather, A., Rather, J., Saleem, S., & Gupta, A. (2024). Assessment of fire safety knowledge, perception and practices among healthcare workers in Srinagar City, India. *Disaster & Development*, Vol. 13, Issue 01, 75–96.
28. Sahebi, A., Jahangiri, K., Alibabaei, A., & Khorasani-Zavareh, D. (2021). Factors affecting emergency evacuation of Iranian hospitals in fire: A qualitative study. *Journal of Education and Health Promotion*, 10, 154. doi:10.4103/jehp.jehp_1478_20
29. Shamaun, R., Nazar, A., Mahnoor, M., Tasneem, S. S., & Jabeen, R. (2024). Understanding the level of knowledge among nurses about fire safety in tertiary care hospital Lahore. *Biological and Clinical Sciences Research Journal*, 2024(1), 1240. doi:10.54112/bcsrj.v2024i1.1240
30. Sholanke, A. B., Ekhaese, E. N., & Ekundayo, P. A. (2024). Users' knowledge of fire safety measures in educational environment: A case study of a college building in Nigeria. *International Journal of Safety and Security Engineering*, 14(1), 135–143. doi:10.18280/ijss.140113
31. Shrivastava, S., & Sawlani, H. (2021). Assessment of awareness and training regarding fire emergencies among undergraduate students of 1st and 2nd proff of Gandhi medical college Bhopal- an interventional study. *Global journal for research analysis: Volume-9 | Issue-8 | August-2020*
32. Singh, A., Mansuri, S., Chaudhari, A., Brahmabhatt, N., Bhabhor, H., & Talsania, N. (2015). An interventional study on awareness regarding first aid and fire safety among the second year undergraduate medical students of BJ Medical College, Ahmedabad. *Int J Sci Stud*, 3(4), 94–99.
33. Soman, S., Rupakumar, L. C., Suresh, N. C., Naik, A., & Guduru, A. A. (2024). A study of fire safety knowledge among health-care professionals in a tertiary care teaching hospital. *Journal (Academy of Hospital Administration (India))*, 36(1), 2–5. doi:10.4103/jaha.jaha_3_24
34. Stennett, J., Hou, R., Traverson, L., Ridde, V., Zinszer, K., & Chabrol, F. (2022). Lessons learned from the resilience of Chinese hospitals to the COVID-19 pandemic: Scoping review. *JMIRx Med*, 3(2), e31272. <https://doi.org/10.2196/31272>
35. Ukegbu, A. U., Njoku, P. U., Metu, K. C., Onyeonoro, U. U., Obiechina, O. C., Ozurumba, C. C., & Ebidan, C. N. (2022). Workplace fire safety: Knowledge and preparedness in a public tertiary healthcare facility in Abia state, south east Nigeria. *Journal of Community Medicine and Primary Health Care*, 34(2), 94–108. doi:10.4314/jcmphc.v34i2.7

36. Yeturu, S. K., Annapurani, R., Janakiram, C., Joseph, J., & Pentapati, K. C. (2016). Assessment of knowledge and attitudes of fire safety – An institution based study. *Journal of Pharmaceutical Sciences and Research*, 8(11), 1281–1284.
37. Zahra, Z., Mohammad, E., Iman, H., & Hadi, D. (2013). Fire safety status in the hospitals of Shiraz University of Medical Sciences, Shiraz, Iran. *International Journal of Occupational Hygiene*, 5, 96–100.